Center for Southeastern Tropical Advanced Remote Sensing (CSTARS)

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LONG-TERM GOAL

We wish to establish a high capability satellite data reception and analysis facility for environmental monitoring in the southeastern US, Gulf of Mexico, Caribbean Basin and Equatorial Atlantic. CSTARS will provide a variety of satellite data and support for scientific research in land, atmosphere, ice and ocean sciences, as well as applied applications in the fields of environmental monitoring, natural hazard assessment, civil defense and defense tactical applications.

SCIENTIFIC OBJECTIVES

To achieve these goals we are developing a high capability receiving and analysis facility for X-band satellite data with a subsequent enhanced capability that would include lower frequency L- and S-band reception. Key priorities in the system design will be high reliability data reception to low elevation angles and rapid data access for all scientific, civilian and defense tactical users.

The specific scientific objectives of this proposed project are, but not limited to, air-sea interaction and ocean dynamics:

1. To explore the further use of SAR imagery for retrieval of high-resolution synoptic wind fields with special emphasis on tropical storms.

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14. ABSTRACT
We wish to establish a high capability satellite data reception and analysis facility for environmental monitoring in the southeastern US, Gulf of Mexico, Caribbean Basin and Equatorial Atlantic. CSTARS will provide a variety of satellite data and support for scientific research in land, atmosphere, ice and ocean sciences, as well as applied applications in the fields of environmental monitoring, natural hazard assessment, civil defense and defense tactical applications.

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2. To examine the surface roughness, wave breaking and directional distribution of the wave field in tropical and extra-tropical storm systems.

3. To explore and quantify mesoscale flow patterns in synoptic and tropical lows.

4. To study in more detail the morphology of hurricanes especially when coupled with information about cloud patterns and precipitation from other sensors.

5. To develop algorithms for improved detection of ships and their location, size and type as well as speed and direction characteristics.

6. To examine ocean features such as fronts, currents and eddies and combine them with measurements of long-range shore-based high-frequency Doppler radars.

7. To study a variety of applications on coastal and river flooding and shoreline changes as well as monitoring of water resources and vegetation and hazards arising from volcanoes.

APPROACH

The new satellite data reception and analysis facility will be located on the former Navy VLBI site at Richmond, in southern Miami-Dade County, Florida, and will be integrated via high speed internet with the university's existing satellite data reception capability at the Rosenstiel School for Marine and Atmospheric Science (RSMAS) campus. It is our intention to make this facility a leading center for environmental remote sensing applications in the southeastern US.

CSTARS applications will be quite diverse. They will include a wide range of scientific applications in land, atmosphere, ice and ocean sciences, as well as more applied applications in the fields of environmental monitoring, natural hazard assessment, civil defense and defense tactical applications. High reliability data reception to low elevation angles (~3 degrees above the local horizon) and rapid data access for all scientific and other civilian users will be key priorities in the system design. CSTARS will initially operate with dual antennas at X-band (~8 GHz frequency), and will be capable of receiving data from a wide variety of low-Earth orbiting satellite (LEOS) systems. Initial operational capability will focus on RADARSAT and SPOT, but will eventually include ERS-2, LANDSAT, AVHRR, ENVISAT, SSMI and additional sensors on NASA's EOS platforms and Seawinds, the Navy's WINDSAT, as well as the Japanese satellites ALOS and ADEOS-II. Subsequent capability may also include lower frequency L- and S-band reception. The facility will be available to support a variety of scientific missions.

WORK COMPLETED

1. The CSTARS satellite reception and processing system has been installed and currently is undergoing an on-site testing phase.

2. CSTARS has successfully tracked RADARSAT-1, SPOT-2/4 and ERS-2 satellite passes.

3. Site preparation and infrastructure work is completed.

RESULTS

The CSTARS facility consisting of the following components: two VIASAT 11.28m antennas, Ingest Archive System (IAS), Product Generation System (PGS), and Data Exploitation System (DES) that have been installed and tested. Figure 1 shows the CSTARS location with the two new antennas and the existing 20-m antenna and Figure 2 shows the hardware for the antenna controllers and data capturing and processing system.

Figure 1: The CSTARS facility in Richmond Heights, Florida with the new two 11.28m X-band antennas (foreground and background).

Figure 2: The computer hardware for the antenna controllers, data reception and processing system.

We have collected our first RADARSAT ScanSAR pass on September 18, 2002 (Figure 3). Currently the station is being certified by RadarSat International as a groundstation. Negotiations for a license agreement are also ongoing.

Figure 3: The first SAR image received at the CSTARS facility on September 18, 2002. The upper left hand corner shows Cape Hatteras and the lower right hand corner shows the Bahamas.

Figure 4 shows a graph of the bit error versus elevation angle. The data show that CSTARS could operate at an elevation angle as low as 2 degrees off the horizon before noise would significantly contaminate the radar signal. This remarkable performance is due to the high G/T characteristics of the antennas.

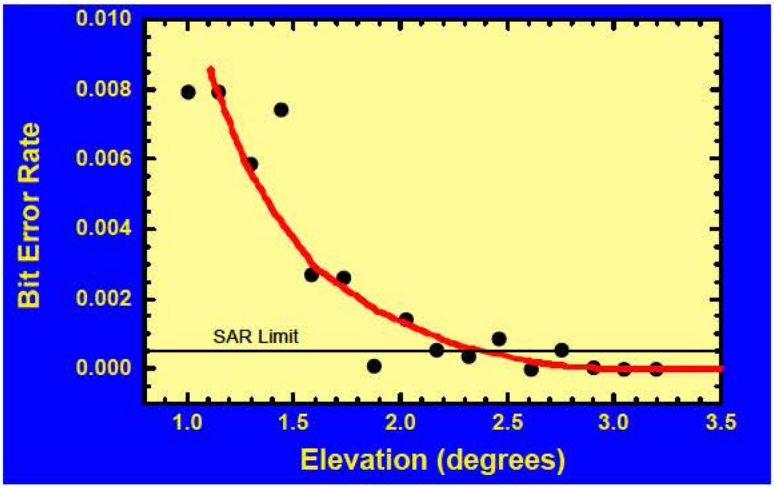

Figure 4: The bit error rate as a function of elevation angle. The data indicate that data reception is feasible to angles as low as 2.5 degrees with significant contamination of the signal.

IMPACT/APPLICATION

The CSTARS facility will exploit the frequent radar and electro-optical satellite coverage of Florida, the Gulf of Mexico and the Caribbean Basin. In particular, CSTARS will make a significant contribution to state and local response in hurricane and flood emergencies. By rapidly providing state and local officials with up-to-date, high-resolution, day or night images of affected areas and by providing quantitative flood extent and qualitative flood and wind damage information, the new system will greatly improve the efficiency of emergency response and relief efforts after natural disasters.

CSTARS will give state officials and researchers a cost-effective method for regional monitoring of environmental hazards and will provide water managers and scientists synoptic images of the entire Everglades watershed. This information will allow near-real time monitoring of water level and hydroperiod, will allow a far better understanding of hydrologic cycle and ecosystem function, and will enable more accurate prediction and management of water availability.

TRANSITIONS

None yet.

RELATED PROJECTS

National Oceanographic Partnership Program (NOPP) project on “Real-Time Forecasting of Winds, Waves and Surge in Tropical Cyclones”. This project will utilize SAR-derived wind speed and morphology of hurricanes to specify the small-scale variability of the wind field. These fields will be used to initialize high-resolution wind fields to force ocean wave and storm surge models.